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Monitoring of shallow landslides using terrestrial laser scanning

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Shallow landslides are geomorphological processes which achieve an extent of 2 to 200 m and a maximum depth of 2 m. They are triggered by heavy rainfall events or rapid snowmelt. In the Alps, an increased occurrence of shallow landslides has been observed in recent decades. In total, these processes lead to a substantial loss of soil and thus degrade meadows and pastures. This study focuses on the use of terrestrial laser scanning (TLS) for multi-temporal monitoring of shallow landslides. The study area contains two shallow landslides and is located in the Schmirn valley in the Tyrolean Alps (Austria). Since 2011 TLS measurements are executed twice a year. First, the TLS point clouds acquired from different positions are pre-processed and registered for each acquisition campaign. Second, the point clouds from all acquisition campaigns are registered relative to each other. Of special interest is the accuracy of registration and improvements by applying an Iterative Closest Point (ICP) algorithm. Registration of multi-temporal scans is especially difficult in this case due to changes in vegetation such as growing and falling trees, growing and cut grassland and changes in the slope itself (i.e. the landslide activity). Small rock faces which are assumed as non-changing serve as natural targets for registration quality control. Using this approach a registration accuracy of less than 5 cm was achieved. Multi-temporal analyses of changes identify erosion and accumulation areas within both landslides. Furthermore, heavy rainfall events in spring 2013, which have caused large damages due to landslide activities and flooding especially in the eastern part of the Tyrolean Inn valley, have also reactivated one landslide at the investigated test site. This is clearly evident in the TLS time series data.